Tropical Atmosphere Ocean (TAO) Refresh

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1. PROJECT SUMMARY

FY2006 funding was expended to refresh the Tropical Atmosphere Ocean (TAO) array as part of the National Oceanic and Atmospheric Administration's (NOAA) effort to "refresh" the TAO system by replacing the obsolete and unsupportable components during the TAO transition from NOAA's Pacific Marine Environmental Laboratory (PMEL) to NOAA's National Data Buoy Center (NDBC). The refreshed TAO system is intended to ensure continuous operation and ongoing integrity of the TAO array. There were two major efforts under this project in FY2006: (1) integration and deployment of two refreshed TAO buoys and (2) Development of refresh TAO data system.

2. FY2006 PROGRESS

2.1 Two Refresh TAO Prototype Buoys

Two refresh TAO prototype buoys were integrated with the refreshed components, some modified designs, and many unchanged legacy TAO design and components (as described in the following).

(1) Refreshed components.
- Use newly-developed data logger AMPS.
- Use Commercial-Off-The-Shelf (COTS) subsurface temperature (T) sensors, conductivity/temperature (CT) sensors, and temperature/depth (TP) sensors, inductive modems (IM), and inductive coupler from Sea-Bird.
- Use the Iridium communication system (Short burst data mode) which can provide hourly high-resolution data.
- Use new Sparton SP3000 internal compass (inside AMPS).

(2) Modified designs
- Surface CT sensor is mounted on bridle using direct connection to the data logger
- Internal battery/electronics design of the electronic tube is modified for the new data logger.
- Explosion mitigation for the electronic tube is provided.

(3) Unchanged legacy designs and components
- ATLAS buoy hull, bridle, and mast design
- Dimensions, location, and mounting of the electronic tube
- Rotronics MP101A air temp/ humidity sensor
- RM Young 5103 anemometer

Note that, D-cell batteries are currently used in the electronic tube. A new power system using lithium batteries was designed and is being tested in the lab. The lithium

battery design will make the electronic tube smaller and lighter, which will make field maintenance much easier and faster. NDBC plans to use this lithium battery design as the refresh TAO configuration after it is fully tested.

The buoy electronic systems were successfully tested in the lab. An intranet webpage was set up to monitor data from all the refreshed systems (including the two refresh prototype buoys, the bench testing system, and spare systems) in the lab and in the field.

The two prototype TAO refresh buoys were deployed at the Gulf of Mexico for field testing. Both buoys are located at 28° 54' 53" N 088° 15' 59" W (Station ID 42A70 and 42B70) with a water depth of 1189m (3900ft), which is 16 nm South of Station 42040.

The moorings for the TAO refreshed buoys are the same as the taut mooring design for the legacy TAO system, which uses 3/8" jacketed galvanized steel wire on the top part as the inductive modem line and 3/4" Nylon rope for the remaining of the mooring. An acoustic release (ORE Offshore 8242XS) is used for easy retrieval of the mooring and attached underwater sensors. Due to the depth and budget limitations, only one conductivity/temperature (CT) sensor (at a water depth of 10m), two temperature (T) sensors (at water depths of 20 and 30m), and one temperature and pressure (TP) sensor (at a water depth of 100m) mounted along the mooring line using inductive modems (IM) for data transmission. In addition, a CT sensor is mounted on the bridle (at a water depth of 1m) and is connected directly to the data logger via a serial connection.

These two buoys were first deployed on August 29, 2006 by R/V Pelican. The following photo shows one of the two TAO refreshed buoys deployed at the Gulf of Mexico. The buoy at Station 42B70 was adrift shortly after deployment and was retrieved at a very shallow location. After examining the battered mooring line, it is clear the line was cut possibly by a fishing or survey vessel. The buoy at 42A70 was successfully deployed and is still on station. Although the met and surface CT data were correctly measured and transmitted, data from underwater T and TP sensors (via IM transmission) were intermittent. NDBC is working with the IM manufacturer Sea-Bird to design a more robust inductive connection. It is planned to redeploy a refreshed TAO buoy at 42B70 and to service the refresh buoy at 42A70 in December 2006.

2.2 Development of Refresh TAO Data System

Compared to limited data transmitted daily from the current ARGOS system, the detailed data collected by AMPS is transmitted hourly via the Iridium SBD system used for the refreshed TAO buoy system. Thus, the shore side data system has to be modified for the much larger data volume in near real time and more frequent data transmission of the refreshed TAO system and to compute the hourly and daily average products now provided from the TAO array. In addition, during the TAO transition and technology refresh, data from the legacy TAO buoys are still transmitted via ARGOS system. So, the new data system for the refresh TAO system also needs to be able to handle the data from the legacy TAO buoys.

This data system for the refreshed TAO buoys includes four components: (1) Ingest system, (2) Real-time processing, (3) Sensor management, and (4) Web display. These components all connect to a centralized sensor/data management database (as shown in the following figure).

Real-time Processing
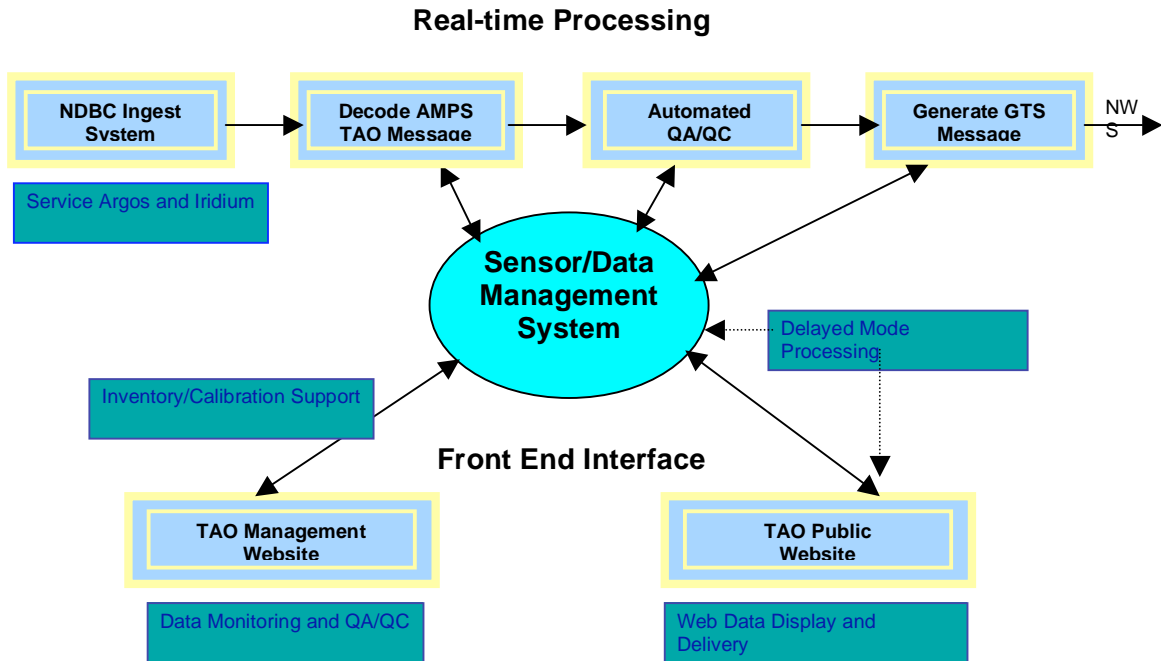
Currently, most of the tasks for developing the data system of the refreshed TAO system are complete. The progress and status of the tasks are summarized in the following.

(1) Migrate fifty-five (55) legacy buoy data to refreshed databases.
- Import current PMEL calibration files to refreshed databases (done)
- Covert daily Argos message to refreshed databases (done)
- Import historical PMEL calibration files to refreshed databases (done)
- Convert historical daily data to refreshed databases (ongoing)
- Convert historical high resolution data to refreshed databases (ongoing)
- Compare converted data with original data (to do)

(2) Data Assembly Center Management Console Development
- Engineering support (done)
- Site/Range limit management (done)
- Sensor management (done)
- Deployment/Recovery management (done)
- QA/QC management (ongoing)
- Data availability report (to do)
- Infrastructure and security (to do)
- QC plotting support (to do)
- On-board management (to do)
- Service Argos account (to do)

(3) Web data display and delivery

- Convert legacy data to new NetCDF format (ongoing).
- Extract and build new NetCDF dataset (ongoing)
- Web data display with new presentation (ongoing)
- Web data delivery via OPenDAP (to do)

(4) Refreshed QA/QC methodologies
- Research static range limits (done)
- Implementation and evaluation (to do)
- Research dynamic range limits (ongoing)
- Research sort term and long term QA/QC methods (to do)
- Load delayed mode data into databases (to do)